

## THE MECHANICAL ARTS IN PERSIA.

ABOUT two or three years ago, Mr. J. Robertson, a civil and mining engineer, who had been professionally engaged in the service of the Shah of Persia, communicated to the Royal Scottish Society of Arts an "Account of the Mechanical Arts of Persia." Of these communications an abstract was afterwards given in the *Edinburgh Philosophical Journal*; and as the details are of a nature which are not commonly treated of in books of travels, we will here give a short notice, illustrated occasionally by references to the works of Fraser and Morier.

The art of carpentry, as understood in this country, can hardly be said to exist in Persia, the greatest effort in this department being confined to the construction of flat roofs of limited span. For forming these roofs a species of poplar is generally employed; but for other purposes oak, plane, and chestnut are used. Hard timber, of small scantling, is sold in bazaars, being brought thither from the forests on the backs of mules or camels. Morier states that in Persia "the people cut their trees about five feet from the ground, burning them a little, and then applying the hatchet," and in another part he remarks that "their mode of felling the tree is susceptible of much improvement; for they first hew it towards the root (by which they injure the finest part of the wood) and then apply the axe."

As to the mode in which the Persian carpenter pursues his work, it is remarked that he follows the Eastern custom of sitting on the ground. Instead of a bench, a strong stake is driven down before him, leaving about ten inches above the ground; and upon this he rests his work, which he keeps steady with his feet. In the Royal Arsenal, however, English tools are used, and a better system of working has been introduced, under the superintendence of British officers; but in the native workshops the workmen are still to be seen squatting on the ground; and as all the tools are adapted for this mode of working, there seems but little reason to look for change, especially among a people who adopt no customs slowly.

Turning in wood is performed by a workman also seated on the ground; two stakes are driven down before him, a short distance apart; and an iron spindle, with a small drum attached, revolves between them. The spindle is passed through the wood which is to be turned, and, with the assistance of a low-and-string, passed round the drum, is made to revolve rapidly. The bow is worked backwards and forwards, while the right hand holds the cutting-tool supported on a block of wood. By combinations of these two modes of working carpentry and turning, a large variety of domestic utensils are made in wood. Thus Mr. Fraser, in his journey to the northern provinces, came to a village where almost every thing was made of wood: "The gates, portals and all, were constructed of wood, and a wooden bridge was thrown across the ditch; the very domestic implements instead of being formed of earthenware or metal, were made of wood. We saw trays, platters, cups, and bowls of this material."

In smith's work the Persians work only on a small scale, and with light and simple tools. The iron generally used is of Russian manufacture, brought by mules from the ports of the Caspian Sea. In the northern parts of Persia, malleable iron is manufactured directly from the ore; and this description of iron has been long esteemed for making excellent horse-shoes and horse-shoe nails. As coal is almost unknown in Persia, the fuel used by the smiths is entirely charcoal prepared from hard wood. The smith stands when the work requires to be heated; but in finishing or making small articles he sits on the ground. The anvil is a small platform without a chimney, having a low wall on one side to prevent the bellows being injured by the heat. Anvil, bellows, hammer, tongs, and drill, form the smith's apparatus.

Working in stone is not much practised in Persia, owing to the buildings being formed chiefly of clay or brick. Grave-stones, mill-stones, and a few other articles, constitute the chief field for this operation. When the work admits of it, the stone-cutter sits upon the ground. The principal tools are, small double-pointed picks and mason-irons resembling large

nails, some pointed and some chisel-shaped. With these tools the stone-cutters work very slowly, and it is only after immense labour that they succeed in bringing a hard stone to the required form. For boring in stone the instrument is an iron rod steeled at the end, but instead of a chisel-point, the end is not flat. Two parallel regular grooves are cut deep across this face, and these are intersected by three others at right angles, thus dividing the end of the rod into twelve compartments. While boring, the hole is kept full of water; and while the rod is turned round gradually with the left hand, the blows are struck by a small hammer held in the right.

As the Persian houses are mostly built of brick, the art of brick-making is rendered one of some importance. A level space of ground having been selected near a stream of water, the grass and vegetable soils are carefully removed. The ground is then broken at one extremity of the prepared platform, and the easily pulverized clay is carefully passed through a small-meshed riddle, and placed in the hollow, while the stones and roots are thrown behind. When a sufficient quantity of riddled clay has been collected, a small stream of water is allowed to flow into the hollow, and the mass is brought to a proper consistency by treading. The prepared clay is now deposited in different small heaps upon the floor, which has been previously spread with finely-riddled earth. The moulds are formed of thin wood, without any of those projections or handles which are seen in this country. For the common-sized brick the mould is formed about nine inches square and one inch and a half deep; but larger bricks are sometimes required for paving courts and coping walls, for which another mould is necessary. The mould is placed on the ground, and the brickmaker, taking a part of the clay in his hands, places it loosely in the mould. He then dips his hands in water, and throws a little of it around the inside of the mould to prevent the clay from adhering to the wood. By a peculiar action of the hands the clay is then drawn from the middle and pressed firmly into the corners and round the sides of the mould; and the whole is afterwards levelled over by a dexterous diagonal stroke of the right hand. The mould is now lifted off the brick and placed to the right hand side, close to, and in the same line with, the brick already formed; and it is again filled up in the same way. Thus he proceeds, frequently washing the mould in water, till a straight line of bricks has been laid down, of many yards in length; a second line is then commenced, exactly the thickness of the mould, from the first; and the whole ground is finally covered with closely-arranged rows of bricks. In two or three days, when the level space has been covered, the first-made bricks become sufficiently dried to be handled; and the brickmaker now proceeds to place them upon edge in lines; in a day or two they are sufficiently hard to be removed, and are then carried to a convenient spot, where they are built up edgewise in form of a wall, one brick in thickness, with small openings between them for the circulation of air. When twenty or thirty thousand have been thus collected, they are removed to a kiln to be burned; or if sun-dried bricks be required, they are at once ready for use.

As there is hardly any coal in Persia, the kilns are heated in a singular manner. The kiln is a small vault, dug out of the ground, and surrounded by a wall of sun-dried bricks, having a doorway at each end for receiving the fuel. Over the vault are several narrow arches, in which the bricks are laid edgewise; and after a fuel of steele refuse, withered plants, and brushwood, has been laid in the vault and kindled, the doorways are closed. In two or three hours dense white smoke rises and escapes at two openings left in the arching, and new fuel is from time to time introduced; but when enough has been thus thrown in, all the openings are closed, and the kiln left for two or three days, till cold, at which time the bricks are found to be sufficiently burned. The bricks thus made have a fine red colour and considerable hardness. It is said that a Persian will prepare the clay and make two thousand of these bricks in a day.

The houses are built either of brick or of clay; if the former, a mortar of clay, chopped straw, and lime, is employed. While building, the workmen do not use a trowel, but lay the

mortar with the hand. The "bond," or mode of arrangement, is simple, as the bricks are square, and do not admit of a very varied arrangement. The mortar-joints are usually from one to two inches thick, and very irregular, unless in arches or doorways, where a good deal of neatness is often exhibited. As timber is scarce, brick arches and domes are common. The mode of making a semi-cylindrical arched roof, without centering, is very singular. After the side walls and gables have been erected, the curve of the arch is marked out upon one of the gables, and this is plastered over with the common clay mortar; a layer of brick is then stuck upon the mortar, and as the bricks are thin and light, they remain firm till the ring is completed, when small eblis are planed into the joints at the opposing ends. When one layer is finished, it is plastered over with mortar, and a second layer is stuck upon it in the same manner, and so on until the whole length of arch is finished. A similarly primitive mode is adopted in the building of domes.

Many of the walls of houses are built hollow, that is, the bricks being so large in surface compared with the thickness, they are so placed, some horizontal and some vertical, as to give smooth outer and inner surfaces to a wall, and yet be full of hollow spaces, whereby material is saved under circumstances where strength is not required. In building the flat roof for dwellings, beams of poplar are laid across, which support small laths. A coarse mat, made of reeds, is placed on the laths; over this a layer of furze; and over the furze a thick layer of clay. The top of the clay is made to slope gently, and is rendered impervious to water by being coated repeatedly with clay and chopped straw.

For houses built of clay the material is generally procured near the intended erection, and is brought to the proper consistency by mixing with water and treading with the foot. For walls a foundation is cut out as far down as the vegetable mould, and this trench is filled up with small stones and clay. The walls are built in courses of about one yard in thickness, each course being allowed sufficient time to consolidate before another is laid. The workman stands upon the top of the wall, and being supplied with pieces of clay by an assistant below, he elevates his arms and throws the mass forcibly down, treading the pieces firmly together with his feet. The layers are brought to the required "batter," and smoothed on the outside, by means of a flat-edged spade. The heat and extreme dryness of the climate soon render a wall of this description hard and firm; they last a very long time, as rain seldom falls. Most Persian villages are surrounded by high walls of this kind, having flanking towers at every angle, and a rude ditch in front, from which the materials were excavated; and even the fortifications of the principal cities are constructed of the same material.

LECTURE II.—The melancholy details relating to the destruction of this magnificent edifice must have been read with painful interest. Luton Hoo owed its magnificence to John, third Earl of Bute, who in 1762 purchased the unfinished mansion of Sir Robert Napier, and soon after resumed upon making a grand addition, in which the genius of Adam should have full scope, regardless of expense. The model adopted by the architect was the Palace of Diocletian at Spalatro; and it is generally admitted that his design was worked out in a very masterly manner. Among the principal apartments, the ceilings of which were ornamented with the best efforts of Cipriani, the library was chiefly remarkable. The relative advantages of cast and wrought-iron girders for building purposes have been clearly shown by the present catastrophe. While, with one exception, the cast-iron girders are still supporting the enormous masses of brickwork forming the cross wall, in the instance of a wrought-iron truss-bridge girder, which pinned the central to the eastern front wall, it has expanded from the heat, and carried with it not only the central wall, but brought out a portion of the eastern front, rendering it positively necessary to take down the whole. Mr. Topham, the surveyor of the San Fire-office, has estimated the cost of restoring the building at between 30,000*l.* and 40,000*l.*—Times.